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Remarks

In response to the Office Action dated 16 June 2006, the Applicant submits this Reply. In view of the following remarks, reconsideration is requested.

Claims 1-14 and 17-20 remain in this application, of which claims 1 and 8 are independent. No fee is due for claims for this amendment.

Rejection Under 35 U.S.C. §102

Claims 1, 2, 8, 9 and 17-20, of which claims 1 and 8 are independent, were rejected under 35 U.S.C. §102 in view of Sasaki[1].

According to Saski, "two images [are] obtained by photographing the diagonal rear environment of the one vehicle at different times with the video camera. . . ."[2] "Corresponding horizontal edges in the respective images are then detected with a correlation window."[3] More particularly, "an edge image . . . is obtained [from which] points having the same y-coordinate values are extracted to provide continuous horizontal edges as noticeable edges."[4] "These horizontal edges are thinned . . . by extracting for example only points of the same y-coordinate values at the edges closer to one vehicle. Such a thinned horizontal edge is used as the noticeable edge."[5] "[A] large correlation window . . . is set around a noticeable edge . . . and . . . is used to detect the corresponding noticeable edge . . . in the [other] image."[6] "Optical flow is then detected from the horizontal edges [i.e., the noticeable edges]."[7] More particularly, "because the optical flow from every point in the thinned horizontal edge has, at the starting point, the same y-coordinate value and has the same movement in the y-direction . . . one optical flow F can be detected between the corresponding thinned horizontal edges in the two images."[8] Thus, Sasaki teaches identifying corresponding lines in two images taken at different times and calculating a vector from the line in one image to its corresponding line in the other image.

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[1] U.S. Patent 6,246,961 to Sasaki, et al.
[2] *Sasaki*, col. 8, lines 31-33.
[3] *Sasaki*, col. 8, lines 34-35.
[4] *Sasaki*, col. 6, lines 44-47.
[5] *Sasaki*, Col. 6, lines 46-51.
[6] *Sasaki*, col. 6, line 64 to col. 7, line 1.
[7] *Sasaki*, col. 8, lines 40-41.
[8] *Sasaki*, col. 7, lines 5-10.

Sasaki does not, as is asserted in the Action, disclose *computing an estimate of motion of the desired characteristic between the two images using a gradient-based method and using the single channel images generated.* Sasaki utilizes a type of "gradient" only in horizontal edge detection, and not in *motion estimation*. For motion estimation, Sasaki utilizes a two-window correlation, such as shown in Figure 6 and described in the associated text.[9] Mathematical algorithms for *gradient-based* functions are distinct from Sasaki's approach of seeking a minimum of window square differences.

Further, the Action asserts that Sasaki inherently uses the optical flow constraint equation, and refers to a printout (hereinafter "Marshall") describing optical flow techniques, which was provided with the Action.

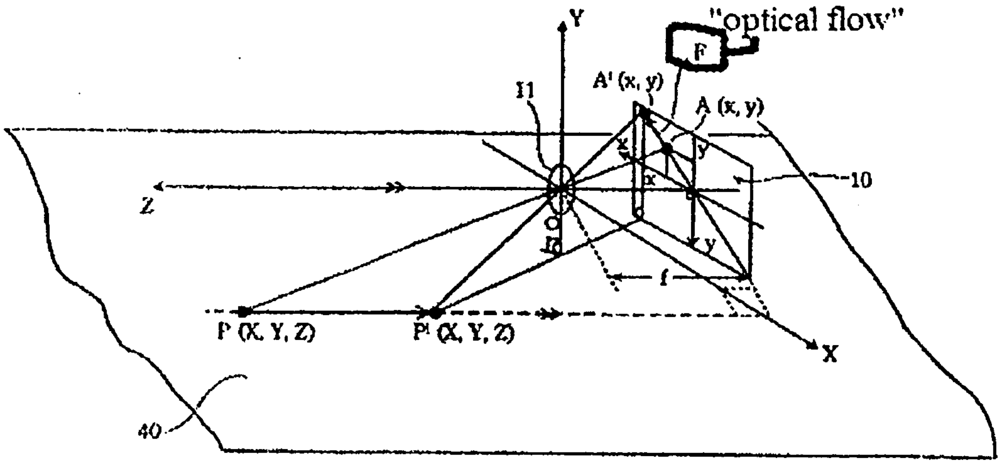
The Applicant respectfully submits that the use of the term "optical flow" in Sasaki is merely coincidental and does not relate to the "optical flow constraint equation" described in Marshall.

The only similarity between Sasaki's computations and Marshall's is the presence of the computation of two speed vectors: $\Delta x/\Delta t = u$, $\Delta y/\Delta t = v$ in Sasaki (Col. 5, lines 42 and 46) and $dx/dt = u_i$ and $dy/dt = v_i$ in Marshall (equation 64). Both of these equations merely define a vector as a speed in the x and y directions respectively.

Marshall, however, describes the optical flow constraint equation (equation 65) as a solution that is derived from Marshall's equation 61 by using an assumption that the intensity of an object in a first image is the same as the intensity of the object in the second image after it has moved a distance in the image.

In contrast, in Sasaki, "optical flow" is merely a computation of a speed vector[10] between two corresponding edges in two images taken at different points in time. This calculation is not based on any constraint like the optical flow constraint equation. Instead, as demonstrated by Fig. 4 of Sasaki and its corresponding description in Col. 5, as reproduced below (with annotation), the speed vector "F" that Sasaki calls "optical flow" is merely based on calculating a vector between two edges:

[9] *Sasaki*, col. 6, line 64 through col. 7, line 27.
[10] *Sasaki*, Col. 4, lines 49-50.



When geometrically considered on FIG. 4, the following equations are obtained.

$$x=fX/Z \quad (1)$$

$$X'=\{(\Delta x/\Delta t)Z+xZ'\}/f \quad (2)$$

$$\text{assuming that } u=\Delta x/\Delta t \quad (3)$$

$$Z=(fX'-xZ')/u \quad (4)$$

Z' here is the relative speed between the other vehicle 30 running in the adjoining lane and the one vehicle 20, and thus assuming that

$$Z'=-\alpha \quad (5)$$

the above equation (4) is

$$Z=(fX'+x\alpha)/u \quad (6)$$

Accordingly, it is aquired that the component of x-direction of the optical flow F ($\Delta x/\Delta t=u$) is

$$u=(fX'+x\alpha)/Z \quad (7)$$

and that the component of y-direction of the optical flow F ($\Delta y/\Delta t=v$) is

$$v=(fY'+y\alpha)/Z \quad (8)$$

None of the equations in Sasaki have anything to do with the "optical flow constraint equation" described by Marshall (equation 65). The equations in Sasaki merely perform the geometric calculation of the speed vector.

Both of the independent claims (1 and 8) as amended require:

a single channel image for each of two input images according to a function that measures, for each pixel, occurrence of a desired characteristic, other than luminance

alone, in the input images at each pixel location to provide a single value for each output pixel in the single channel image from a range of values that represent a likelihood of the occurrence of the desired characteristic,

an estimate of motion of the desired characteristic between the two images using a gradient-based method and using the single channel images generated for the two input images and using as a constraint that a total of the desired characteristic is constant from one image to a next image."

Sasaki's computation of a single speed vector between two edges is not a method that *uses as a constraint that a total of the desired characteristic is constant from one image to a next image* where the desired characteristic is something *other than luminance alone*. None of the equations in Sasaki (namely those reproduced above that describe Sasaki's calculation of "optical flow") has any indication of such a constraint. Sasaki does not teach that a total measure of some characteristics, such as the edge magnitude, is constant from one image to the next. The Action relies on an argument that "optical flow" in Sasaki inherently uses such a constraint, and points to Marshall. Marshall describes an optical flow constraint equation which is derived by assuming that which the total intensity (i.e. luminance) is constant from one image to the next. In contrast, the claims require motion estimation to be based on a desired characteristic *other than luminance*, the total measure of which is constrained to be constant from one image to the next. Thus, it is error to assert that Marshall illustrates the inherency of this claim limitation in Sasaki.

Accordingly, this rejection of independent claims 1 and 8 is respectfully traversed.

Claims 2, 9, 17, 18, 19 and 20 are dependent claims that are allowable for at least the same reasons.

Additionally, regarding dependent claims 19 and 20, the technique in Sasaki does not produce, for each pixel in an image, a vector that describes the motion for the pixel from one image to the next. The Action repeats the assertion that claim 19 does not appear to further limit claim 1. Since claim 1 does not recite the limitations of claim 19, Applicant does not understand this assertion. Moreover, Sasaki only produces a single vector for each pair of corresponding edges that is detected, and therefore does not produce *for each pixel in an image, a vector that*

describes the motion for the pixel from one image to the next, as claimed. Accordingly, dependent claims 19 and 20 further distinguish the invention from Sasaki.

Rejections Under 35 U.S.C. §103

Dependent claims 4-6 and 11-13 were rejected under 35 U.S.C. §103 in view of Sasaki and U.S. Patent 4,924,310 ("Von Brandt"). Dependent claims 3 and 10 were rejected under 35 U.S.C. §103 in view of Sasaki and U.S. Patent Publication 2002/0159749A1 ("Kobilansky"). Dependent claims 7 and 14 were rejected under 35 U.S.C. §103 in view of Sasaki, Von Brandt and Kobilansky.

These rejections are respectfully traversed as claims 3-7 and 10-14 are allowable for at least the same reasons as the claims from which they depend.

Regarding the dependent claims 3, 7, 10 and 14, these claims are also allowable for the following additional reasons.

Kobilansky only teaches, at best, that motion estimation should take into account the proximity to a color. In particular, in paragraph [0015], Kobilansky teaches a motion estimating technique that computes displacement vectors for regions in an image, ensuring that a "region r of a reference image is reasonably well mapped to a region r+d(r) of a target frame." Kobilansky merely says that the "region r+d(r) in target frame should have image properties like . . . color close to those of the region r in the reference frame." This portion of Kobilansky does not teach generating a single channel image based on a desired characteristic where that desired characteristic is color proximity. The Examiner is respectfully requested to indicate where Kobilansky specifically teaches generating such a single channel image. The Action merely refers to paragraph [0015] from which the relevant language is quoted above and which does not teach generating a single channel image based on color proximity.

Regarding the proposed combination of Kobilansky and Sasaki, the Action merely asserts that the combination would be made to "provide enhancements to the process of estimating motion." There is no explanation of how Sasaki could be modified so as to replace or modify Sasaki's computation of a speed vector between detected edges with some other calculation (not taught by Kobilansky) that uses color proximity. The Action does not describe what this proposed modification would have been in sufficient detail to permit the claims to be compared to it.

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Accordingly, claims 3, 7, 10 and 14 are distinguishing over Sasaki (or Sasaki and Von Brandt) and Kobilanksy.

Conclusion

In view of the foregoing remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this reply, that the application is not in condition for allowance, the Examiner is requested to call the Applicants' attorney at the telephone number listed below.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, please charge any fee to **Deposit Account No. 50-0876.**

Respectfully submitted,

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